

Soybeans to Car Parts

Purpose: Students investigate the collaborative work of an agricultural scientist and engineer to find new uses for an agriculture product (soybeans). This lesson can be used as an opportunity to discuss how scientists and engineers are continuing to experiment and use technology to invent new bio-based products.

Time: 45 minutes

Level: 4

Materials:

- Newspaper - 4"x4" piece for each student or team
- Plastic cups
- Silken tofu
- Stir stick
- Microwave Oven

Glossary

Bio-based – material or product derived from biological or renewable resources

Coagulate – change to a solid or semi-solid state

Protein – Organic compounds, polymer chains of amino acids

Tofu – coagulated soy protein made from soy milk

Industrial uses for agriculture crops used in non-food manufacturing include: replacements for petroleum, newsprint, wood resins, rubber, and degradable plastics.



Minnesota Science Standards and Benchmarks

4.1.2.2.1 Identify and investigate a design solution and describe how it was used to solve an everyday problem.

4.1.3.3.1 Describe a situation in which one invention led to other inventions.

Background

George Washington Carver was born to slave parents in Missouri during the civil war. He worked as a farmhand in Kansas where he earned a high school education in his late 20s. Carver was the first black student to attend Iowa State Agricultural College where he earned a bachelor's and master's degree. He left Iowa and became a very influential scientist at the Tuskegee Institute in Alabama. By convincing farmers in the South to plant peanuts as an alternative to cotton, Carver helped revitalize the area's agriculture and became one of the most respected and influential scientists in the country. Carver is also known for his efforts in discovering that soybeans were a valuable source of protein and oil.

Like Carver, Ford was very interested in the soil science and the potential of alternative crops like peanuts and soybeans to produce plastics, paint, fuel and other products. In 1942 Ford showcased a car with a lightweight plastic body made from soybeans. Ford and Carver corresponded via letter in the early 1930s and developed a deep respect for each other that led to collaborative efforts in scientific and technology advancement for the agricultural and automobile industries.

This lesson and experiment allows students to create a bio-based product. The term bio-based can be defined as a material or product derived from biological or renewable resources. The car parts made from soybeans are an example of bio-based products. During the process of making a bio-based product, the students will heat the soybean protein found in tofu. This heating process causes the protein to coagulate – change from a solid to a semi-solid. Students can analyze the product they create and develop ideas for how it could be used.

Procedure

1. Collect 10-15 items from around your home or classroom. Examples: tools (jammer, screwdriver, pliers, etc.) kitchen utensils (fork, spoon, cup, spatula, pizza cutter, etc.), school supplies (pencil, ruler, scissors, eraser, etc.), toys (stuffed animals, cars, etc.)
2. Display the items to the students and ask them to brainstorm ideas for things they could make from the items you have collected. Examples: musical instruments, trap for insects/pests, a shelter, something that can spin, etc.

3. Praise the students for their creative thinking. Inform the students that many times scientists are creative and are constantly thinking of new ways to improve the things that we need to survive or make our life easier. Many times they try to develop uses for products that are renewable resources – like plants.
4. Read the Background Information. Students can read on their own, as a small group or as a class. Ask students:
 - a. How did George Washington Carver and Henry Ford work together to make car parts using soybeans?
 - b. How were these two men and their team of scientists creative?
 - c. How are scientists and engineers still working together to invent new products that use living things (bio-based products)?
5. Model the process to follow to create a bio-based product.
 - a. Tear the 4”x 4” piece of newspaper into small strips and place in a plastic cup.
 - b. Add water until the newspaper is soaked. Stir the mixture so a slurry forms.
 - c. Add 2 tablespoons of silken tofu to the slurry and mix until a consistent mass is formed. Add more tofu if needed for consistency.
 - d. Remove mass from cup and squeeze out extra water. Shape into a ball.
 - e. Place in microwave oven and cook on high for 10 minutes. Check to see if the ball is hard. If not continue cooking and checking for periods of 3 minutes.
 - f. Remove ball and cool.
6. Allow students to follow the procedure for creating a bio-based product. Answer questions and assist where needed.
7. Allow students to examine their bio-based product. Ask the students:
 - a. How could you use this product?
 - b. How does the product you made compare to how George Washington Carver and Henry Ford used bio-based products in the automobile industry?

Additional Activities

- Investigate and research engineering careers related to the agricultural and automotive industries.
- Invite a local soybean producer to visit your classroom and share information about growing and raising crops for food and other uses.
- Plant soybean seeds in soil and make observations as they grow.
- Encourage students to explore other bio-based products.

Resources

- MN Ag in the Classroom has soybean and crop focused resources including:
 - Commodity Card set –featuring MN plants and animals
<http://www.mda.state.mn.us/kids/commoditycards.aspx>
 - Videos featuring MN farm families and the livestock and crops they produce.

<http://www.mda.state.mn.us/kids/videostories/feedus.aspx>

- Children's Agricultural Literacy Book Bundle – includes books that fit with this lesson: The Super Soybean, Soybeans in the Story of Agriculture, George Washington Carver.

<http://www.mda.state.mn.us/news/publications/kids/maitc/bookbundle.pdf>

- The Minnesota Soybean Research and Promotion Council has information, stories by soybean growers, and examples of soybean products and their value in our lives at <http://therealstorymn.com/> and <http://www.mnsoybean.org/>

Adapted from 4-H Agri-Science Curriculum, Robert L. Horton PhD Ohio State University Extension.

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Background Information

Did you know that a scientist and an engineer invented a way to make car parts out of plants? Not using roots and stems and leaves. Instead they worked with the oil and protein from the seed.

George Washington Carver is a famous American scientist who began his research in his own backyard. He experimented with peanuts, cotton, soybeans and dozens of other plants. In 1904 George Washington Carver discovered that soybeans were a valuable source of protein and oil that could be used to make industrial products as well as food.

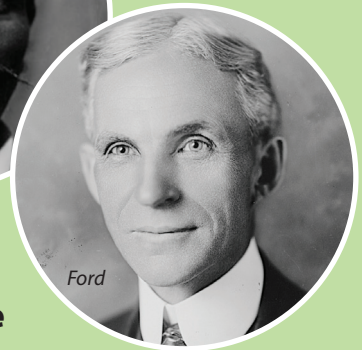
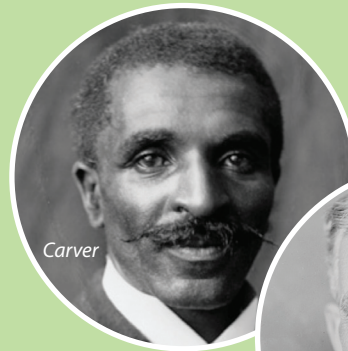
Henry Ford is a recognized industrialist and founder of the Ford Motor Company who is known for inventing the assembly line and for his famous automobile, the Model T Ford.

George Washington Carver shared his scientific discoveries with his good friend Henry Ford. Mr. Ford owned a large research facility. He came to the lab one day with a huge bag of soybeans. Dumping them out on the floor, he told a team of young scientists,

"You guys are supposed to be smart. You ought to be able to do something with these soybeans."

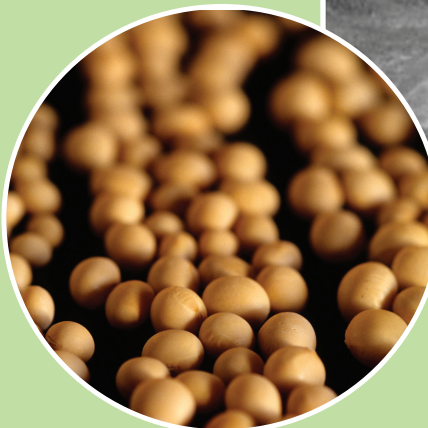
In time, Carver and the team of scientists in Ford's lab made a strong enough plastic for the gearshift knobs, horn buttons, window frames, accelerator pedals, light-switch assemblies and ignition-coil casings. They also fashioned the exterior of an automobile from "soybean plastic." It was the protein from the soybeans that under heat was made into the hard plastic parts for Ford's cars. By 1935 Mr. Ford was using one bushel of beans for every car he manufactured.

(60 pounds = 1 bushel)



What was the science behind the work of the two friends?

Biology and chemistry help explain the problems that Carver and Ford and the young scientists were trying to solve while they were working with the soybeans. George Washington Carver and Henry Ford experimented with heating the protein in soybeans to produce a biobased material, soy protein plastic, that was strong enough to be used to make car parts.



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